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Literature Review

# OSH Management in Small and Medium Enterprises: A Bibliometric Review

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## ABSTRACT

Sustainable Small and medium-sized enterprises (SMEs) are crucial to economic growth but face significant challenges in occupational safety and health (OSH). SMEs often lack the resources, expertise, and institutional support needed to manage OSH effectively, leading to higher rates of workplace accidents. This study addresses the lack of thematic synthesis and trend forecasting by offering a structured overview of the field's intellectual landscape. Using bibliographic coupling and co word analysis, we identified key research themes, emerging trends, and influential studies. Data were collected from the Web of Science (WoS) Core Collection (1990 to 2024) yielding 552 initial records. After screening, 393 journal articles were analysed, with a total of 6,408 citations (6,181 excluding self-citations), an average of 16.31 citations per item and an H-index of 39. Applying a 30-citation threshold, 54 highly cited papers were subjected to bibliographic coupling, revealing six thematic clusters. The analysis indicates four prominent clusters: (1) the role of human resources in OSH programs, (2) health certifications and safety management systems, (3) employee perceptions of OSH efforts, and (4) the development of OSH models tailored to SMEs. Consequently, our findings demonstrate that OSH research in SMEs is steadily evolving toward more integrated, systematic management approaches. These insights suggest that enhancing OSH outcomes requires targeted strategies including strengthening human resource roles, adopting formal safety frameworks, emphasizing risk assessment and staff training, and implementing standardized practices fit for the SME context.

**Keywords:** small and medium enterprises (SMEs), OSH management systems, occupational safety and health, bibliometric analysis

## INTRODUCTION

Small and medium-sized enterprises (SMEs) are fundamental to economic development worldwide, particularly in Malaysia [1], [2]. They make significant contributions to national income, job creation, and industrial expansion [1], [2], [3], [4]. In Malaysia, SMEs are officially categorized based on employee count and annual revenue. Manufacturing SMEs are defined as those with fewer than 200 employees or less than RM50 million in sales, while service-based SMEs must have fewer than 75 employees or sales under RM20 million to qualify [5] [6]. The classification of SMEs into micro, small, and medium categories is detailed in national policy guidelines, as shown in Figure 1. This classification helps in identifying the different operational scales of SMEs and is essential to understanding their distinct challenges, particularly in managing occupational safety and health (OSH).

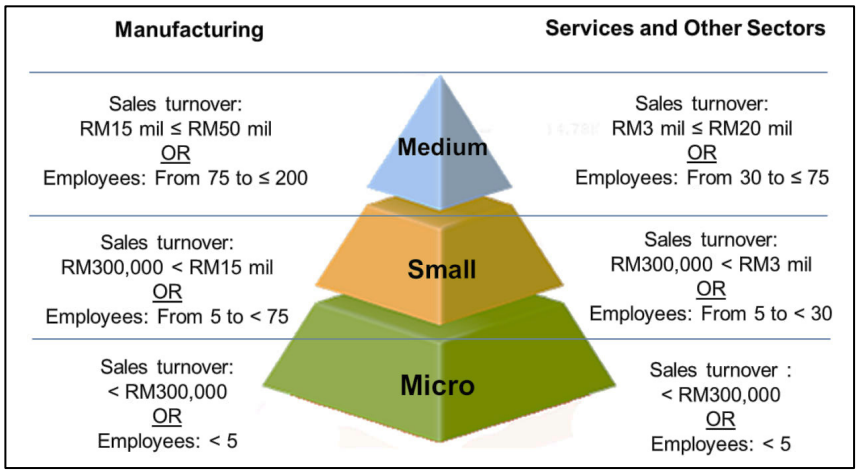


Figure 1. Detailed definition of the category, namely micro, small, and medium [1]

Despite their importance, SMEs often struggle with managing OSH due to their limited capacity, lack of formal systems, and restricted access to professional expertise [7]. Research shows that SMEs tend to face similar OSH-related challenges regardless of geographic location. For instance, Canadian SMEs lack structured return-to-work programs for injured employees [8], Indian SMEs experience difficulties predicting accidents due to poor data systems [9], and businesses in Kosovo often fail to provide adequate safety training or personal protective equipment [10]. In Malaysia, studies reveal a widespread lack of compliance with OSH standards, particularly in the construction and manufacturing sectors. Ismail [11] found that many SMEs in Kelantan perform poorly in safety due to limited training and weak enforcement. Likewise, Belayutham and Ibrahim [12] observed low safety compliance among SME contractors. These issues indicate systemic weaknesses in OSH implementation that make SMEs more vulnerable to accidents and injuries.

According to national data, SMEs contribute to a high proportion of workplace incidents in Malaysia [13], [14]. Reports from the Department of Occupational Safety and Health (DOSH) revealed 34,216 occupational injuries in 2022, a sharp increase of nearly 59% compared to the previous year. Non-fatal injuries rose to 33,899, while fatal injuries also increased to 317 cases, with a rate of 2.06 deaths per 100,000 workers [15]. These alarming statistics show the growing seriousness of OSH problems in SMEs and highlight the need for better safety systems and support [16][17].

Occupational safety can be defined as the condition of being protected from harm or risk, especially in work environments where people face various hazards [18]. It includes strategies and systems designed to prevent injuries, illnesses, and accidents during work activities. The scope of OSH is not limited to physical safety but also includes psychological well-being and the safety of all individuals in a workplace, including employees, contractors, and visitors [19], [20]. In Malaysia, legal responsibilities for OSH are outlined in the Occupational Safety and Health Act (OSHA) 1994. These laws require employers to ensure a safe working environment for their staff [2], [21], [22]. Institutions like DOSH and the National Institute of Occupational Safety and Health (NIOSH) are responsible for implementing and enforcing OSH regulations. DOSH oversees inspections and legal compliance, while NIOSH focuses on training, education, and awareness programs. However, even with these frameworks in place, compliance among SMEs remains weak. Many employers and employees are unaware of their legal obligations under OSHA 1994, and limited resources further prevent proper implementation of safety practices [14], [23], [24].

In recent years, there has been a growing recognition of the need for systematic OSH practices tailored to SMEs. Traditional safety systems, often designed for large organizations, are not always practical for smaller businesses due

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to cost, complexity, and lack of specialized staff. Consequently, many SMEs operate in high-risk environments without formal safety frameworks or standard procedures [25], [26], [27]. This situation has led researchers and policymakers to advocate for more adaptable, simplified, and scalable OSH systems that reflect the specific operational realities of SMEs. Among the most frequently recommended strategies is the implementation of structured risk-management tools such as the Hazard Identification, Risk Assessment, and Risk Control (HIRARC) framework [28] [29]. While HIRARC offers a systematic method for safety risk management, its adoption within SMEs is limited by constraints in financial resources and staffing [30]. Another key development is the use of safety certifications such as ISO 45001 and OHSAS 18001. These certifications promote standardized practices and demonstrate a business's commitment to safety [31], [32]. While some SMEs have benefited from certification in terms of improved internal processes and compliance [31], [32], [33], [34] others find it difficult to meet the requirements without external assistance.

Human resources play a pivotal role in strengthening OSH outcomes. Studies have shown that when HR departments are actively involved in safety planning and training, businesses tend to experience better safety performance and employee satisfaction [35], [36], [37], [38]. For instance, Ogunyomi et al. [37] found a a positive correlation between HR practices and OSH performance in Nigerian SMEs. Similarly, Sorensen et al. [38] reported that employees in companies with structured OSH systems felt more confident in their workplace safety. These findings highlight the importance of integrating HR functions into OSH management efforts. Employee perceptions are another critical factor in shaping safety outcomes. Research indicates that many SME workers see OSH programs as mere legal requirements rather than meaningful efforts to protect their well-being [11], [26]. This perception reduces their motivation to follow safety procedures, especially when training and communication are lacking. Encouraging employee participation in OSH planning, risk identification, and feedback sessions can foster a stronger safety culture and shared responsibility within the organization, [23], [39].

Despite these advances, there are still gaps in the literature, especially regarding the development of OSH framework and model specifically designed for SMEs. Most existing frameworks do not fully consider the limited capacity and informal structures of small businesses. To address this, scholars have begun proposing customized OSH systems that are practical, flexible, and easy to adopt. Cagno et al. [40] developed an interpretive model for OSH in SMEs, while Masi et al. [41] designed a pilot framework for implementing and evaluating safety interventions. These models consider both the technical and behavioral aspects of OSH and aim to bridge the gap between theory and application.

Given the rapid growth and dispersion of OSH research in SMEs, a bibliometric analysis is essential to systematically map thematic patterns and intellectual connections. To better understand the current research landscape and identify future directions, this study uses a bibliometric approach. Bibliometric analysis involves the use of quantitative methods to analyze patterns in academic literature. It provides a structured way to identify influential publications, research themes, and knowledge gaps in a specific field [42], [43], [44]. In particular, this study applies two bibliometric techniques: bibliographic coupling and co-word analysis. Bibliographic coupling helps identify connections between highly cited papers by analyzing shared references, while co-word analysis examines the frequency and co-occurrence of key terms to reveal thematic trends. Recent bibliometric reviews have confirmed the value of these methods in understanding complex research fields like OSH. For instance, studies using co-word analysis have revealed core themes such as safety culture, certification systems, employee perceptions, and model development in SME contexts [34], [41], [42]. These themes highlight the multidimensional nature of OSH research, which covers organizational behavior, regulatory frameworks, risk management, and performance outcomes. At the same time, bibliographic coupling helps to identify the most influential works and authors that have shaped the field's development over time [43].

Therefore, this study aims to contribute to the growing body of knowledge on OSH in SMEs by conducting a bibliometric review of research published between 1990 and 2024. The analysis is based on journal articles indexed in the Web of Science (WoS) Core Collection, selected for their relevance and citation impact. The study has two main objectives:

1. To evaluate the current state of OSH research in SMEs using bibliographic coupling, which highlights the key themes and intellectual structure of the field; and
2. To identify emerging trends and future research directions in OSH for SMEs through co-word analysis.

By achieving these objectives, the study aims to provide both theoretical insights and practical recommendations. For researchers, the results offer a roadmap for exploring new areas of investigation. For managers and policymakers, the findings suggest strategies to improve OSH systems in SMEs, such as integrating HR functions, promoting employee engagement, adopting scalable models, and seeking appropriate certifications. In the long term, these actions can help SMEs build safer workplaces, improve productivity, and contribute to sustainable economic growth.

In conclusion, although SMEs face numerous obstacles in managing OSH, recent research and practical developments have paved the way for more tailored, data-driven solutions. This study seeks to organize the existing knowledge, highlight what has been achieved, and point out what still needs to be done to ensure safety and well-being in small and medium enterprises. The next sections present the methods used in the bibliometric analysis and the detailed findings derived from the dataset.

This paper is structured as follows. This section outlines the occupational safety and health in SMEs. Section 2 presents the methodological approach using bibliometric analysis comprising the bibliographic coupling and co-word analysis. Next, Section 3 presents the results and discussion on the clusters produced from the two analyses. Section 4 deduced the theoretical and managerial implications of the study. Sections 5 and 6 offer the limitations and suggestions for future works. Finally, Section 7 concludes the study.

## METHODS

### Bibliometric Approach

This study uses a bibliometric approach to explore the research landscape on Occupational Safety and Health (OSH) in Small and Medium Enterprises (SMEs). Bibliometric analysis helps reduce personal bias by using data from a wide range of studies to show patterns and trends in research [42], [43]. Two key methods are used: bibliographic coupling and co-word analysis. Bibliographic coupling groups studies that share similar references, helping to identify common research topics within a specific time frame. Co-word analysis, on the other hand, looks at the frequency of words used in article titles, abstracts, and keywords to uncover important themes and predict future research directions. These methods help map the structure of OSH research in SMEs and highlight areas where more research is needed. Figure 2 shows the flowchart for this study.

Figure 2 shows the step-by-step process used in this study's bibliometric analysis. It starts with data collection from the WoS database using keywords related to SMEs and OSH. The next step involves data filtering, where only relevant journal articles are selected. Duplicates and unrelated records are removed, resulting in a final dataset for analysis. The resulting dataset formed the foundation for further filtering and analysis in the subsequent bibliometric mapping process. Duplicate entries were removed by matching titles, authors, and publication years using Excel's 'Remove Duplicates' feature, supplemented with conditional formatting to visually verify accurate record retention. Then, two types of bibliometric techniques are applied: bibliographic coupling, which groups articles based on shared references, and co-word analysis, which detects frequently used terms. The results from both techniques are

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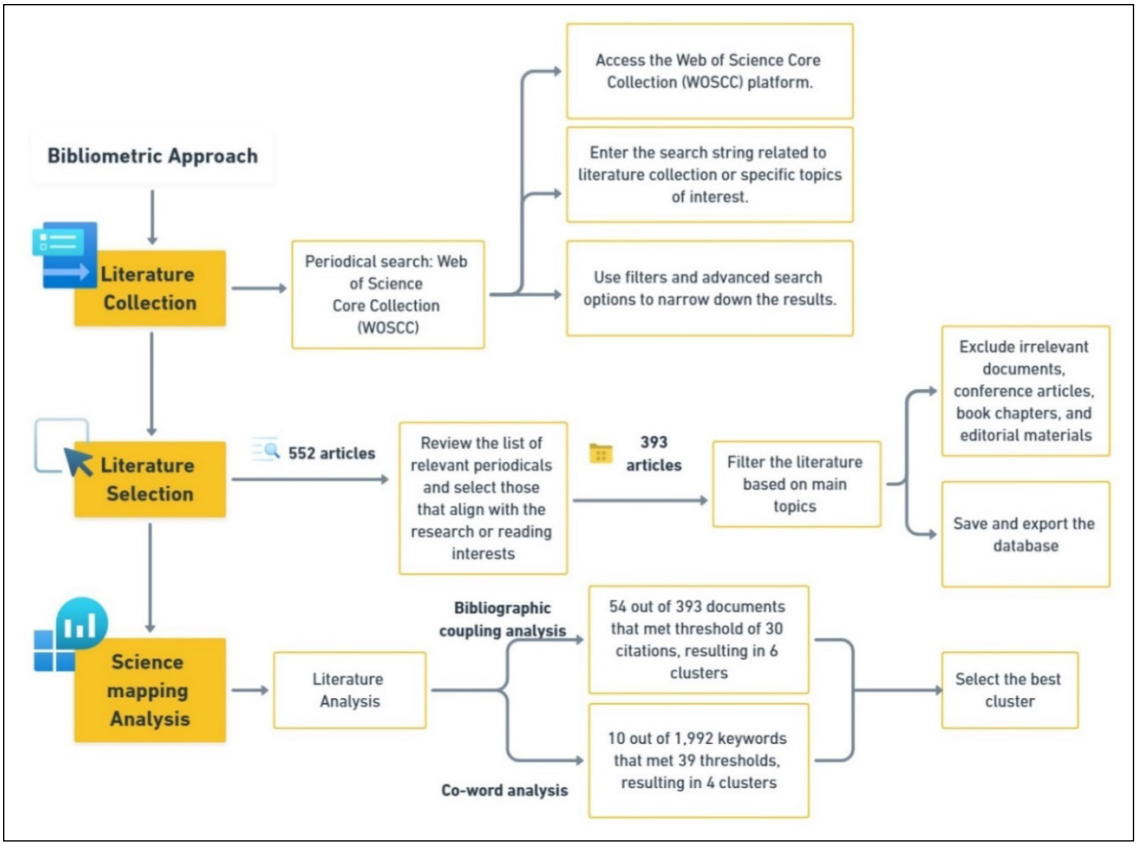


Figure 2. Research flowchart for Bibliometric Analysis of OSH in SMEs

visualized using bibliometric software which is VOSviewer, generating maps that display relationships between articles or keywords. These maps are grouped into clusters, with each cluster representing a different thematic area in OSH-SME research. The flowchart ends with the interpretation phase, where results are analyzed to understand the current state of research and identify gaps for future studies.

### Research Design and Data Collection Procedure

To ensure a comprehensive and reliable dataset for this bibliometric study, we applied a carefully developed search strategy using relevant keywords derived from previous literature, thesauri, and dictionaries [42]. The keywords targeted core concepts related to “small and medium enterprises” (SMEs), “occupational safety,” “health and safety,” and related terms (as detailed in Table 1). The search Search String using the WoS, which was chosen for its high level of academic rigor and long-standing reputation as a dependable scientific database. Only English language

Table 1. Search string in WoS database

| Keywords | Justification |
|---|---|
| "small medium" OR "small and medium*" OR "small & medium" OR "SME*" | To identify literature related to small and medium firms. |
| "safety and health" OR "OSH*" OR "health and safety" OR "safety & health" OR "health & safety" | To identify literature related to safety and health |

publications were included to maintain consistency and clarity in data processing. We restricted results to journal articles and reviews to prioritize high-quality, peer-reviewed research. Other categories including conference proceedings, editorials, book chapters, and meeting abstracts were excluded.

According to Pranckute [44], WoS has provided reliable indexing for over four decades, offering broad coverage of peer-reviewed, high-impact journals. To ensure consistency and avoid duplication errors, we followed the recommendation by Donthu et al. [42] to rely on a single database rather than merging datasets from multiple sources. Although some scholars, such as Echchakoui [45], have proposed integrating Scopus and WoS for broader bibliometric investigations, using a single curated database helps maintain data quality and reduces the risk of analytical inconsistencies [46]. Nevertheless, we recognize that relying solely on WoS may skew our dataset toward English-language, high-impact, and Western-published journals, potentially underrepresenting region-specific or non-English OSH–SME research present in Scopus, Dimensions, or Google Scholar. While acknowledging limitations, we retained WoS due to its robust metadata quality, standardized indexing, and compatibility with bibliometric tools such as VOSviewer and Bibliometrix.

## RESULT AND DISCUSSION

The search in WoS was performed on 27 February 2024. The initial document count was 552. After filtering solely journal publications, the total number of papers was 393. Total citations received were 6,408 and 6,181 (excluding self-citations). The average number of citations per item was 16.31, with an H-index of 39. Figure 3 illustrates the publication and citation trends on OSH management in SMEs from 1990 to 2024. The research interest in this field remained minimal until 1996, after which the number of publications steadily increased, indicating growing academic attention. The citation count also shows a significant upward trend, reflecting the rising impact of this research area. This growth highlights the increasing recognition of OSH issues within SMEs as a critical area of study, especially in line with the evolving economic role of SMEs globally.

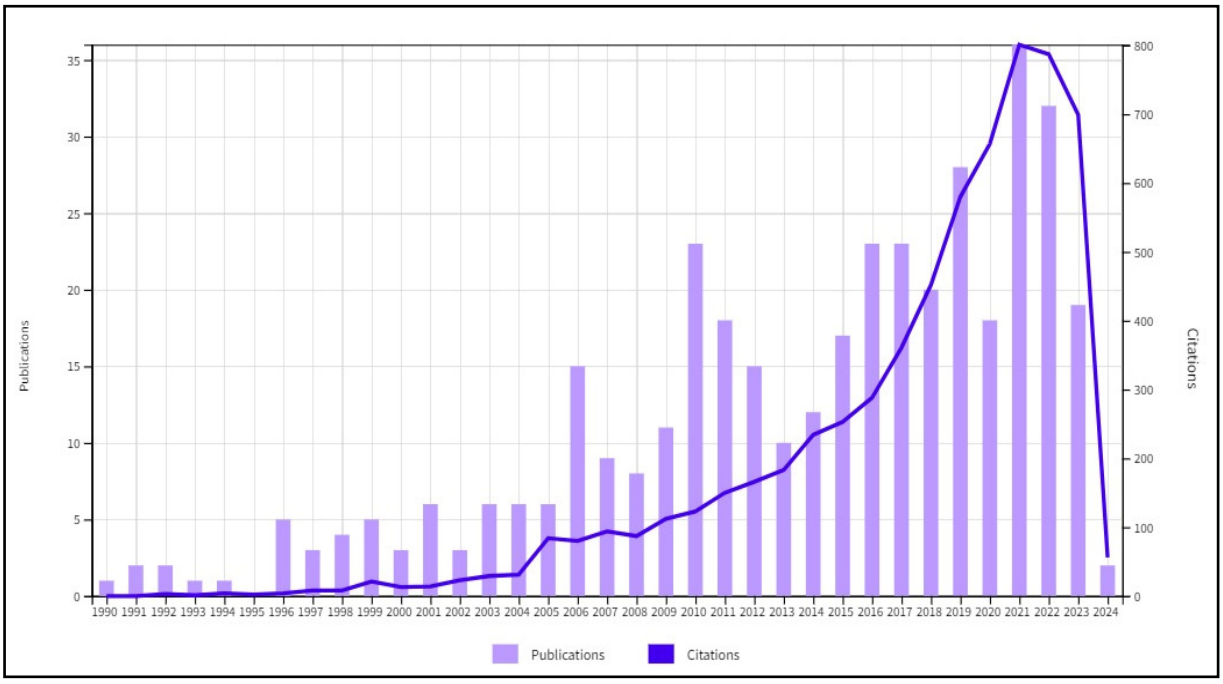


Figure 3: Number of publications and citations on OSH Management in SMEs
(source: Web of Science)

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Table 2. Top 10 documents in bibliographic coupling analysis

| Rank | Publication | Scope | Citation | Total link strength |
|---|---|---|---|---|
| 1. | Cagno et al. [40] | An interpretive model of occupational safety performance for Small- and Medium-sized Enterprises | 56 | 56 |
| 2. | Cagno et al., [27] | Identification of OHS-related factors and interactions among those and OHS performance in SMEs | 47 | 48 |
| 3 | Masi et al. [41] | Developing, Implementing and Evaluating OSH Interventions in SMEs: A Pilot, Exploratory Study | 36 | 48 |
| 4 | Bonafede et al. [26] | OHS management and employers' perception: differences by firm size in a large Italian company survey | 35 | 38 |
| 5 | Arocena et al. [23] | An empirical analysis of the effectiveness of occupational health and safety management systems in SMEs | 84 | 33 |
| 6 | Bianchini et al. [25] | An innovative methodology for measuring the effective implementation of an Occupational Health and Safety Management System in the European Union | 30 | 32 |
| 7 | Kheni et al. [47] | Health and Safety Management within Small- and Medium-Sized Enterprises (SMEs) in Developing Countries: Study of Contextual Influences | 69 | 27 |
| 8 | Kheni et al. [48] | Health and safety management in developing countries: a study of construction SMEs in Ghana | 52 | 24 |
| 9 | Segarra et al [49] | Occupational risk-prevention diagnosis: A study of construction SMEs in Spain | 37 | 13 |
| 10 | Santos et al. [31] | The main benefits associated with health and safety management systems certification in Portuguese small and medium enterprises post quality management system certification) | 66 | 13 |

## Bibliographic Coupling

From the initial dataset of 393 journal articles, a subset of 54 highly cited documents was selected for bibliographic coupling analysis. These documents met a minimum citation threshold of 30, a level chosen to balance the inclusion of influential studies with the need to avoid overly dense or fragmented clusters. This threshold was determined through iterative testing to ensure that the resulting network map produced distinct and meaningful clusters without over-filtering key contributions or under-filtering noise. The selected documents were then grouped into six thematic clusters, but only four clusters will be focused on and explained in detail in the next section. Each cluster represents a different research stream within the field of OSH in SMEs. The top three documents with the highest total link strength (TLS), a measure of the number and strength of shared references, were authored by Cagno et al. [40] (56 TLS), Cagno et al. [27] (48 TLS), and Masi et al. [41] (48 TLS), highlighting their central influence within the citation network. These clusters served as the foundation for thematic synthesis and further discussion in the results and implications sections of this study.

Table 2 shows that the top 10 documents in this bibliographic analysis were chosen based on their total link strength (TLS) to represent the most influential publications cited. Because bibliographic coupling is based on two documents

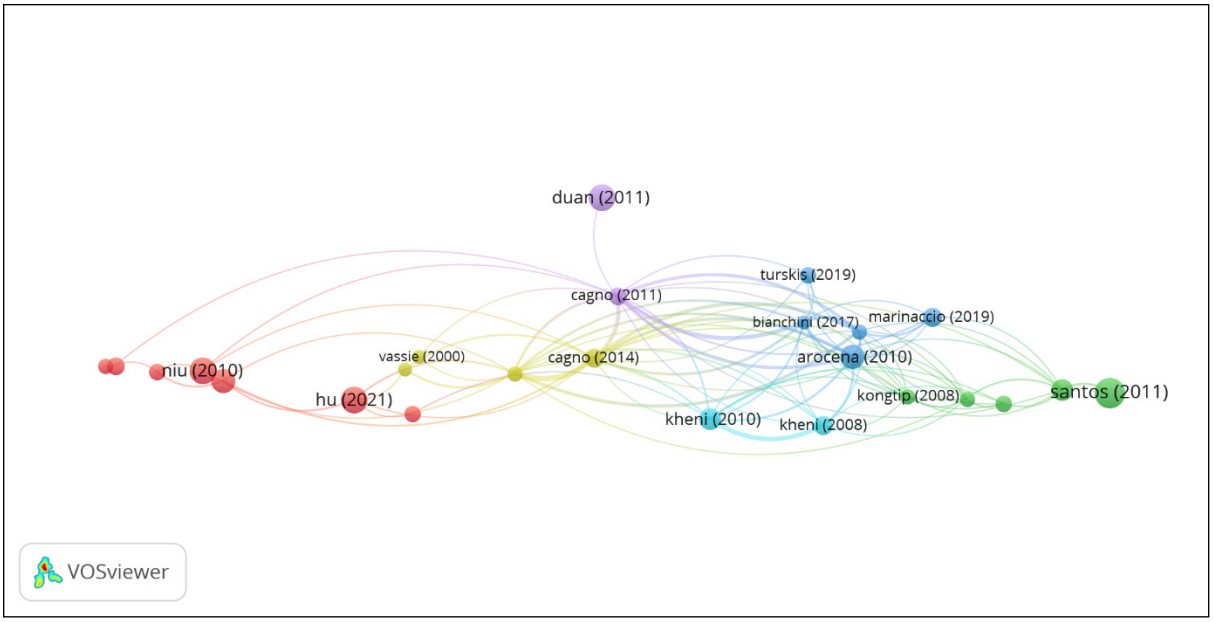


Figure 4: Bibliographic coupling of OSH management in SMEs (Source: Author's work)

that share a third publication in the reference, a far more relevant metric for measuring their impact is total link strength (TLS). Bibliographic coupling results in four distinct clusters:

- Human Resources role in Occupational and Safety Health program
- Health management certification and safety management systems
- Employees' perception of the OSH program in an organization
- Model of OSH in SMEs

Figure 4 presents the bibliographic coupling network of 54 highly cited documents, grouped into six clusters. Each node represents a publication, with node size and thickness of links indicating the strength of citation connections (Total Link Strength, TLS). The most influential publications, Cagno et al. [40] (56 TLS), Cagno et al. [27] (48 TLS), and Masi et al. [41] (48 TLS) appear at the center of dense clusters, reflecting their central role in shaping research themes. Among the six clusters, only four (red, green, blue, and yellow) were selected for deeper analysis due to their thematic richness and sufficient number of documents. These clusters represent key streams in OSH research for SMEs, including HR involvement, certification systems, employee perception, and OSH model development. The exclusion of the two smallest clusters (purple and light blue) is based on their limited size and weaker citation links, which are insufficient for generating coherent thematic insights.

The remaining two clusters (purple and light blue), each containing only two papers, were excluded as their small size limited the ability to form coherent themes. Following best practices in VOSviewer, we set a minimum cluster size of five documents. According to Donthu et al. [42], clusters with minimal publications often lack thematic depth and exhibit weak citation links, reducing their relevance within the broader research landscape [45]. Additionally, very small clusters may introduce analytical noise and represent fringe or outdated topics that are not aligned with current research trends [43]. Including them could compromise the clarity and focus of the study. As noted by Pranckute [44], such clusters are also less likely to reflect meaningful or emerging directions in the field. Therefore, excluding these clusters ensures that the analysis remains focused on well-established and influential research streams in OSH management among SMEs.

Cluster 1 (red): The first cluster with the highest number of documents, which is seven documents labeled "Human Resources role in Occupational and Safety Health program", shows that the OSH program is crucial to be organised

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by HRM in any firm. Ogunyomi et al. [37] mentioned that multiple regression results indicate a direct association between human resources management and occupational safety and health. The employees in companies with improved safety and health management from baseline to follow-up reported enhanced satisfaction with the health and safety activities [50]. The International Labour Organization (ILO) approaches ergonomics to improve the working environment, referring to occupational safety and health, and then prescribes their considerations [51].

Cluster 2 (green): Cluster 2, with five documents, is stated as "Health management certification and safety management systems" that needed to be practiced in SMEs. Santos et al. [32] mentioned that the main advantages Portuguese SMEs have gained from the preferred certifications have been upgrading their inner organization and overall image. The study found a moderately positive link between OHSMs and SMEs' performance, which, if OHSMs were not adequately carried out, would affect the performance of SMEs [52]. Santos et al. [31] also stated that Portuguese SMEs have benefited from suggested certifications through compliance with regulations, improved working conditions, and communication about risks and hazards.

Cluster 3 (blue): Cluster 3, with five documents, stands for "Employees' perception of OSH program in the organization" since the OSH program is related to the workers. Microenterprise management needed to be more confident in the effectiveness of occupational risk assessment and management actions. Employers of microenterprises more commonly saw OHS as a legal requirement than an added value [26]. Companies that supplement traditional technical preventive actions with people and organization-oriented practices are the most efficient in reducing workplace accidents. In SSEs, advanced OHS systems are severely underdeveloped [23]. Only the exemption of employers' obligations through successful implementation of the OHSMS, along with an appropriate incentive scheme, can considerably improve occupational health and safety [25].

Cluster 4 (yellow): Within four documents, this cluster is labeled "Model of OSH in SMEs". Identifying all the OSH factors applicable to SMEs was necessary for the model's design [40]. To help practitioners from SMEs design, carry out, and assess their OSH interventions in an "ideal" manner, future research should be focused on an increasingly applicable approach [41]. While hazards were lower in certain SMEs, others saw increased risks related to safety-related issues. Most SMEs need more safety management models [53].

The following table 3 presents the summary of the bibliographic coupling analysis with cluster number and colour, labels, number of publications, and representative publications. Beyond individual cluster descriptions, it is essential to synthesize how these clusters interact and align. Cluster 1 and Cluster 3, for instance, both focus on human factors.

Table 3: Bibliographic coupling analysis on KM in SMEs

| **Cluster no and color** | **Cluster label** | **Number of publications** | **Representative publication** |
|---|---|---|---|
| 1 (red) | Human Resources role in Occupational and Safety Health program | 7 | Ogunyomi [37], Sorensen et al [38], Torp et al [50], Niu et al [51], Edward et al [54], Hu et al [55], Ikpe et al [56], |
| 2 (green) | Health management certification and safety management systems | 5 | Santos et al [31], Santos et al [32], Segarra et al [49], Gopang et al [52], Kongtip et al [57], |
| 3 (blue) | Employees' perception of the OSH program in an organization | 5 | Arocena et al [23], Bianchini et al [25], Bonafede et al [26], Marinaccio et al [58], Turskis et al [59] |
| 4 (yellow) | Model of OSH in SMEs | 4 | Cagno et al [40], Masi et al [41], Unnikrishnan et al [53], Vassie et al [60] |

Cluster 1 emphasizes HR's role in managing OSH programs, while Cluster 3 explores how employees perceive and respond to these efforts. Together, they highlight the importance of workforce engagement in shaping safety outcomes. In contrast, Cluster 2 and Cluster 4 emphasize system-level structures such as certifications and formal OSH models. While these clusters suggest more top-down strategies, they also complement the people-centered themes from Clusters 1 and 3 by providing a structured framework to support implementation. This convergence indicates that an effective OSH strategy for SMEs must integrate both system-based and behavioural approaches.

**Co-word Analysis**

Applying the same database, the co-word analysis shows 10 out of 1,992 keywords that met 39 thresholds, resulting in four clusters. Table 4 shows that the most commonly used terms are "SMEs" (46 occurrences), "health" (38 occurrences), and "occupational health" (35 occurrences).

Figure 5 illustrates the co-word network of frequently occurring keywords, where each node represents a keyword and link strength indicates co-occurrence across documents. The most prominent keywords, "SMEs," "health," and "occupational health", are centrally located with larger node sizes, showing their dominant presence in the literature. The network is divided into four thematic clusters:

- Cluster 1 (Red): Safe and healthy workplace culture
- Cluster 2 (Green): Behavior, risk assessment, and stress management
- Cluster 3 (Blue): OSH models for sustainability and performance
- Cluster 4 (Yellow): OSH interventions in SME management

These clusters reflect the main focus areas in OSH-related studies for SMEs and reveal the multidimensional nature of safety research, which includes technical, behavioral, and managerial aspects. The network also shows moderate density, indicating active but still fragmented research connections that suggest opportunities for further integration in future studies.

Table 4: Top 15 keywords in the co-occurrence of keywords analysis

| Rank | Keyword | Occurrences | Total link strength |
|---|---|---|---|
| 1. | SMEs | 46 | 111 |
| 2. | Health | 38 | 95 |
| 3. | Occupational-Health | 35 | 119 |
| 4. | Management | 34 | 96 |
| 5. | Performance | 34 | 78 |
| 6. | Safety | 31 | 69 |
| 7. | Occupational Health and Safety | 26 | 62 |
| 8. | Impact | 23 | 65 |
| 9. | Health And Safety | 21 | 42 |
| 10. | Model | 18 | 62 |
| 11. | Safety Management | 14 | 56 |
| 12. | Interventions | 13 | 56 |
| 13. | Culture | 13 | 47 |
| 14. | Climate | 12 | 45 |
| 15. | Firm Size | 11 | 48 |

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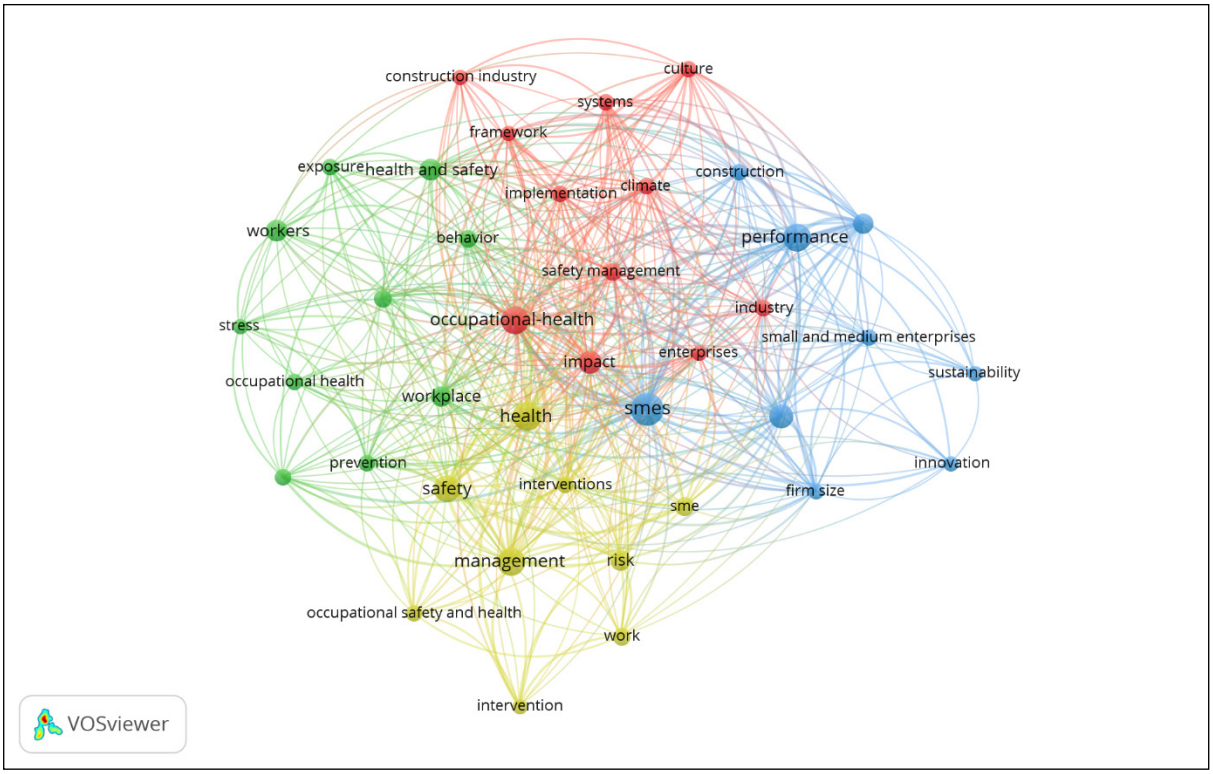


Figure 5: Co-word analysis on OSH management in SMEs
(Source: Authors' work)

Cluster 1 (red): Cluster 1, with 11 keywords, is labeled as "Safe and Healthy Workplace Culture". The mining sector has developed and adjusted to advances in organizational safety science, as demonstrated by the examination of the development and existence of safety culture in a sample of mining reports that OHS commissioned studies [39]. The findings show a positive correlation between top management compliance with regulatory requirements for the minimum content of OSH systems and mandated OSH training. This indicates that developing strong occupational safety and health management systems depends on implementing mandated OSH training [30]. The study findings validated that the performance of construction projects is influenced by the culture surrounding occupational safety and health. The culture surrounding these issues is crucial when influencing employee behaviour around workplace safety and health [33].

Cluster 2 (green): Cluster 2, with ten keywords, is stated as “Emphasizing health and safety through behaviour, risk assessment, and stress management”. Niebuhr et al. [61] mentioned that the findings show that work-from-home (WFH) needs legal regulations and offers a place to begin interventions since the weekly percentage of WFH influences stress-related symptoms. It also has a detrimental effect on job satisfaction. In order to evaluate the safety and health of the Construction Workers (CWs), a Holistic Occupational Health and Safety Risk Assessment Model (HOHSRAM) is created in the current study [62]. According to Lee et al. [63], a sizable portion of healthcare workers had mental health problems related to employment, sociodemographic data, the workplace, interactions with COVID-19 patients, and unhealthy behavior.

Cluster 3 (blue): Cluster 3, with nine keywords, is defined as “OSH Model to ensure the sustainability and performance for SME”. According to Malesios et al. [29], structural equation modeling and multiple linear regression are the most commonly used methods for analyzing the sustainability of SMEs to establish a greener environment. A maturity model for micro, small, and medium enterprises (MSMEs) was applied in Colombia, revealing that 6% were at an insufficient level, 31% were at an initial level, 45% had acquired sustainability maturity, and 18% were at

a consolidated level. The results suggest that decision-makers in the latter group prioritized building sustainability progress skills and defining a maturation path [64]. Khanzode et al. [65] mentioned that improved administrative control can improve the firm's chances of achieving sustainable production goals.

Cluster 4 (yellow): Cluster 4, with nine keywords, is defined as "OSH interventions in occupational management for SMEs". Tejamaya et al. [66] identified downstream factors (OSH training, commitment, risk management, and communication), middle-stream factors (third-party support), and upstream factors (government role) that impact OHSMS adoption in micro, small, and medium. Dugolli [10] found that the intervention process is influenced by contextual factors such as participation and the workplace environment, as well as obstacles such as a lack of resources and information. The study showed that health and safety practices significantly impact the safety and performance of small and medium enterprises [24].

A summary of the co-word analysis is presented in Table 5, comprising cluster number and color, cluster labels, number of keywords, and representative keywords.

## Implications

### *Theoretical implications*

The results of this study offer several theoretical implications based on the synthesis of bibliographic and co-word analyses. Cluster 1 (Red, bibliographic coupling) and Cluster 1 (Red, co-word) both emphasize the role of human factors, such as leadership, communication, and safety culture. For example, Ogunyomi et al. [37] and Sorensen et al. [38] found that HRM practices are positively associated with improved safety performance in SMEs, aligning with the frequent use of keywords such as "culture," "framework," and "systems" in the co-word network. This supports the theoretical claim that organizational culture and employee engagement are central components of effective OSH strategies in SMEs.

Table 5: Summary of co-word analysis on KM in SMEs.

| Cluster No and color | Cluster label | Number of keywords | Representative Keywords |
|---|---|---|---|
| 1 (red) | Safe and Healthy Workplace Culture | 11 | Climate, construction industry, culture, enterprises, framework, impact, implementation, industry, occupational health, safety management, systems. |
| 2 (green) | Emphasizing H&S through behavior, risk assessment, and stress management | 10 | Behavior, exposure, health and safety, occupational health, prevention, risk assessment, small and medium-sized enterprises, stress, workers, workplace. |
| 3 (blue) | OHS Model to ensure the sustainability and performance of SMEs. | 9 | Construction, firm size, innovation, model, occupational health and safety, performance, small and medium enterprises, smes, sustainability. |
| 4 (yellow) | OSH interventions in occupational management for SMEs. | 9 | Health, intervention, interventions, management, occupational safety and health, risk, safety, sme, work. |

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Cluster 2 (Green, bibliographic) highlights the importance of certification systems such as ISO and OHSAS in improving regulatory compliance and internal safety structures. Santos et al. [31],[32], demonstrated that certified SMEs reported better safety outcomes and organizational alignment. This is further reinforced by the keyword cluster that includes "certification," "implementation," and "management." These findings contribute to the theory by showing that formal safety structures are not only beneficial for legal compliance but also for shaping internal safety behavior.

Cluster 3 (Blue, bibliographic) and Cluster 2 (Green, co-word) focus on employees' perceptions of OSH systems. Bonafede et al. [26] and Arocena et al. [23] reported that workers in SMEs often view safety practices as regulatory burdens rather than value-added initiatives, especially when training or communication is weak. This suggests that theoretical models of OSH in SMEs must account for employee attitudes and the behavioral dimensions of implementation.

Lastly, Cluster 4 (Yellow, bibliographic) and Cluster 3 (Blue, co-word) both support the development of OSH models tailored to SMEs. Cagno et al. [40] and Masi et al. [41] proposed adaptive, scalable frameworks for OSH that align with SMEs' structural limitations. Keywords like "model," "sustainability," and "performance" underscore the literature's growing focus on integrating OSH into the broader strategic goals of SMEs. Theoretically, this indicates a shift from compliance-based models toward integrated, performance-oriented frameworks that consider both safety and sustainability.

It is worth noting that both bibliographic coupling Cluster 4 and co-word analysis Cluster 3 focus on the theme of OSH model development in SMEs. However, while bibliographic coupling identifies the most influential publications (e.g., Cagno et al. [40], Masi et al. [41]) that contribute to this theme, the co-word analysis highlights frequent terms such as "model", "performance", and "sustainability", which reflect the prominence of this topic across the literature. Rather than being redundant, the convergence of these findings from two different analytical methods reinforces the central importance of OSH model development in addressing SME-specific safety challenges. The bibliographic analysis provides insight into the intellectual roots and key contributors to the theme, while the co-word analysis reveals its evolving presence in research discussions. This distinction helps to clarify the complementary contributions of each method.

### *Managerial Implications*

The managerial implications of this study are derived directly from the clusters and keyword analyses, ensuring that recommendations are grounded in the data. These implications are tightly linked to analytical findings and supported by literature within each cluster, offering SME managers targeted, evidence-based strategies.

#### *Integrate HR into OSH planning*

As seen in Cluster 1 (Red, bibliographic), studies by Ogunyomi et al. [37] and Sorensen et al. [38] show that HRM involvement enhances safety culture and communication. SMEs should empower HR departments to take a leading role in safety training, feedback loops, and employee safety engagement. For example, manufacturing SMEs with internal HR-led OSH programs report fewer compliance issues and improved worker satisfaction.

#### *Pursue safety certifications*

Cluster 2 (Green) supports the implementation of formal safety systems like ISO 45001 and OHSAS 18001. Santos et al. [31], [32] reported improved safety outcomes and organizational efficiency in SMEs adopting these

certifications. Managers should not view certification as a compliance checkbox but as a strategic tool to formalize safety responsibilities and monitor performance metrics.

*Engage employees in safety processes*

Cluster 3 (Blue) highlights the role of employee perceptions. Bonafede et al. [26] and Arocena et al. [23] showed that when employees feel excluded from safety planning, their motivation to comply decreases. Managers should actively involve employees in safety audits, feedback sessions, and hazard identification to foster shared responsibility.

*Develop adaptable OSH models.*

Cluster 4 (Yellow) and co-word Cluster 3 emphasize scalable OSH frameworks suited for SMEs. Studies by Cagno et al. [40] and Masi et al. [41] recommend modular models that adapt to SME size and industry. For instance, in service-based SMEs, simplified digital tools for reporting and monitoring have proven effective without overburdening staff.

### Limitations

This study has several limitations. First, it relied solely on the Web of Science database, potentially omitting relevant literature indexed in Scopus or other databases. The significant reason for using only WOS is that the science mapping of bibliometric analysis from WOS for this research shows better results than SCOPUS. Furthermore, WOS is the most reliable and robust database on a 40-year-old scientific platform [44]. Second, only journal articles were included; conference papers, books, and grey literature were excluded to maintain quality and consistency, which may limit coverage [43][67]. In addition, the primary justification for adding journals is to restrict the database to peer-reviewed literature to guarantee the quality of the generated clusters [68]. Third, the inclusion of only English-language publications introduces language bias and may underrepresent studies from non-English-speaking regions, especially from Asia, Latin America, or Africa, where relevant research may be published in local languages. This may result in regional bias and reduce the generalizability of the findings across global SME contexts. Furthermore, the keyword strategy. Although developed systematically, it may have missed relevant studies that used alternative or industry-specific terminology for OSH-related concepts. This keyword sensitivity may affect the inclusiveness of the dataset and could lead to thematic gaps in the cluster and co-word analyses. Lastly, the earliest number of literature references found in WOS related to the study is only 552 articles, which seems relatively low and becomes lower after including only journals. These limitations should be addressed in future research by expanding the database sources, including multilingual publications, and refining the keyword selection strategy to enhance coverage and reliability.

## CONCLUSION

This bibliometric review provides an overview of research trends and thematic developments in OSH management among SMEs, based on an analysis of 393 journal articles using bibliographic coupling and co-word techniques. The findings highlight four key themes: the role of human resources in OSH, the adoption of certification systems, employee perceptions of safety programs, and the need for SME-specific OSH models. These themes reflect a gradual shift from compliance-based practices to more integrated and participatory approaches. The review contributes theoretically by organizing fragmented literature and practically by offering guidance to SME managers, including strategies such as involving HR in safety planning, implementing ISO 45001, and engaging workers in OSH initiatives. The insights are also relevant for various stakeholders such as, entrepreneurs can benchmark OSH maturity, policymakers can design targeted support measures, academicians can investigate regional and sectoral gaps, and investors may assess OSH as a factor in long-term business resilience. Future research should expand on

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under-represented regions, adapt existing frameworks to SME contexts, explore integration with digital and sustainability goals, and apply more inclusive, multilingual, and longitudinal approaches for broader relevance.

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## CONFLICT OF INTERESTS

The author declares that there are no conflicts of interest regarding the authorship or publication of this research.

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## References

[1] E. Endris and A. Kassegn, "The role of micro, small and medium enterprises (MSMEs) to the sustainable development of sub-Saharan Africa and its challenges: A systematic review of evidence from Ethiopia," *J. Innov. Entrepreneurship*, vol. 11, Art. no. 20, Feb. 2022.

[2] J. A. Yeow, D. W. K. Khong, T. S. Chin, and A. Yusof, "Enforcement of OSH regulations in Malaysia's manufacturing sector: An empirical investigation," in *Proc. Int. Conf. Law Digitalization (ICLD 2022)*, Atlantis Press, 2022, pp. 5–14, doi: 10.2991/978-2-494069-59-6_2.

[3] A. Zafar and S. Mustafa, "SMEs and its role in economic and socio economic development of Pakistan," *Int. J. Acad. Res. Account. Finance Manag. Sci.*, vol. 7, no. 4, 2018.

[4] H. Anto et al., "Causal threads: SMEs and macroeconomic indicators in Indonesia," *J. Small Bus. Strategy*, vol. 35, no. 2, pp. 82–95, 2025.

[5] "Analysis of the impact of SMEs' production output on Kazakhstan's economic growth using the ARDL method," *Economies*, vol. 13, no. 2, Art. no. 38, 2023.

[6] SME Corporation Malaysia, "Guideline for new SME definition," 2022. [Online]. Available: https://www.smecorp.gov.my

[7] R. Stasiak-Betlejewska, "Occupational health and safety management in Polish enterprises. Problems and challenges," *Syst. Saf. Human-Tech. Facil.-Environ.*, vol. 4, no. 1, pp. 128–134, 2022.

[8] I. Nastasia and R. Rives, "Successful strategies for occupational health and safety in small and medium enterprises: Insights for a sustainable return to work," *J. Occup. Rehabil.*, Dec. 2024, doi: 10.1007/s10926-024-10255-2.

[9] R. R. Saxena, "Intelligent approaches to predictive analytics in occupational health and safety in India," *arXiv*, preprint arXiv:2412.16038, 2024.

[10] M. Dugolli, "Occupational health and safety situation at small and medium enterprises in Kosovo, contextual factors, barriers, drivers and intervention process," *Int. Rev. Appl. Sci. Eng.*, Jan. 2021, doi: 10.1556/1848.2020.00110.

[11] N. N. H. Ismail, "Employees' perceptions towards the relationship between safety management practices and safety performance of SMEs industry in Kelantan," *Int. J. Entrep. Manag. Pract.*, vol. 3, no. 11, pp. 1–9, Sept. 2020.

[12] S. Belayutham and C. K. I. Che Ibrahim, "Barriers and strategies for better safety practices: The case of construction SMEs in Malaysia," *Constr. Econ. Build.*, vol. 19, no. 1, Art. no. 6331, Jun. 2019, doi: 10.5130/AJCEB.v19i1.6331.

[13] S. K. Wong, "Importance of safety and health regulations for all," *New Straits Times*, 2021.

[14] A. A. Aziz, M. E. Baruji, M. S. Abdullah, N. F. N. Him, and N. M. Yusof, "An initial study on accident rate in the workplace through occupational safety and health management in sewerage services," *Int. J. Bus. Soc. Sci.*, vol. 6, no. 2, pp. 29–255, 2015.

[15] Department of Occupational Safety and Health, Malaysia, "Slide Hebahan Statistik Kemalangan dan Penyakit Pekerjaan Negara 2022," 2022. [Online]. Available: https://www.dosh.gov.my/index.php/statistik-kemalangan-penyakit/2022-7/4600-slide-hebahan-statistik-kemalangan-dan-penyakit-pekerjaan-negara-2022/file. [Accessed: Nov. 11, 2024].

[16] K. T. Hong, L. Surienty, and D. K. M. Hung, "Occupational safety and health (OSH) in Malaysian small and medium enterprises and effective safety management," *Int. J. Bus. Technopreneursh.*, vol. 1, no. 4, pp. 321–338, Nov. 2011.

[17] L. Surienty, K. T. Hong, D. Kee, and M. Hung, "Occupational safety and health (OSH) in SMEs in Malaysia," *J. Global Entrepreneurship*, vol. 1, no. 1, pp. 65–75, 2011.

[18] National Institute for Occupational Safety and Health, *Current Intelligence Bulletin 69: NIOSH Practices in Occupational Risk Assessment*, DHHS (NIOSH) Publication No. 2020-106 (rev. 03/2020),

[19] Cincinnati, OH: CDC, Mar. 2020, pp. x–xi. [Online]. doi: 10.26616/NIOSHPUB2020106revised032020 D. Towlson, *Health & Safety at Work for Dummies*, 1st ed., Hoboken, NJ: Wiley, 2016, ch. 1, pp. 1–2.

[20] National Institute of Occupational Safety and Health Malaysia (NIOSH), "About us," *NIOSH Malaysia*, 2024. [Online]. Available: https://www.niosh.com.my/about-us/

[21] Department of Occupational Safety and Health (DOSH), *Occupational Safety and Health Act 1994 (Act 514)*, Ministry of Human Resources Malaysia, Kuala Lumpur, 2006. [Online]. Available: https://www.dosh.gov.my

[22] Department of Occupational Safety and Health (DOSH), *Control of Industrial Major Accident Hazards (CIMAH) Regulations 1996*, Ministry of Human Resources Malaysia, Kuala Lumpur, 1996.

[23] P. Arocena and I. Núñez, "An empirical analysis of the effectiveness of occupational health and safety management systems in SMEs," *Int. Small Bus. J.*, vol. 28, no. 4, pp. 398–419, Aug. 2010, doi: 10.1177/0266242610363521.

[24] Y. Hou, M. Khokhar, M. Khan, T. Islam, and I. Haider, "Put safety first: Exploring the role of health and safety practices in improving the performance of SMEs," *SAGE Open*, vol. 11, no. 3, Jul. 2021, doi: 10.1177/21582440211032173.

[25] A. Bianchini, F. Donini, M. Pellegrini, and C. Saccani, "An innovative methodology for measuring the effective implementation of an occupational health and safety management system in the European Union," *Safety Sci.*, vol. 92, pp. 26–33, Feb. 2017, doi: 10.1016/j.ssci.2016.09.012.

[26] M. Bonafede et al., "OHS management and employers' perception: Differences by firm size in a large Italian company survey," *Safety Sci.*, vol. 89, pp. 11–18, Oct. 2016, doi: 10.1016/j.ssci.2016.05.012.

[27] E. Cagno, G. J. L. Micheli, and S. Perotti, "Identification of OHS-related factors and interactions among those and OHS performance in SMEs," *Safety Sci.*, vol. 49, no. 2, pp. 216–225, Feb. 2011, doi: 10.1016/j.ssci.2010.08.002.

[28] T. M. B. T. Nordin, H. A. Aziz, N. F. M. Salleh, M. A. F. M. Azmi, and K. H. Ramli, "Emerging risks management in small and medium-sized enterprises," in *AIP Conf. Proc.*, vol. 2682, no. 1, Feb. 2023, doi: 10.1063/5.0123456.

[29] C. Malesios, D. De, A. Moursellas, P. K. Dey, and K. Evangelinos, "Sustainability performance analysis of small and medium-sized enterprises: Criteria, methods and framework," *Socio-Econ. Plann. Sci.*, vol. 75, 2021, doi: 10.1016/j.seps.2020.100993.

[30] Ø. Dahl, T. Rundmo, and E. Olsen, "The impact of business leaders' formal health and safety training on the establishment of robust occupational safety and health management systems: Three studies based on data from labour inspections," *Int. J. Environ. Res. Public Health*, vol. 19, no. 3, 2022, doi: 10.3390/ijerph19031269.

[31] G. Santos, S. Barros, F. Mendes, and N. Lopes, "The main benefits associated with health and safety management systems certification in Portuguese SMEs post quality management system certification," *Safety Sci.*, vol. 51, no. 1, pp. 29–36, Jan. 2013, doi: 10.1016/j.ssci.2012.06.014.

[32] G. Santos, F. Mendes, and J. Barbosa, "Certification and integration of management systems: The experience of Portuguese SMEs," *J. Cleaner Prod.*, vol. 19, no. 17–18, pp. 1965–1974, Nov. 2011, doi: 10.1016/j.jclepro.2011.06.017.

[33] M. Djaelani, E. A. Sinambela, D. Darmawan, and R. Mardikaningsih, "Strengthening the culture of occupational safety and health as a contributor to the formation of construction project performance," *J. Mark. Bus. Res.*, vol. 1, no. 2, pp. 2807–9175, 2021, doi: 10.56348/mark.v1i2.34.

[34] M. Dugolli, "Occupational, health and safety situation at small and medium enterprises in Kosovo, contextual factors, barriers, drivers and intervention process," *Int. Rev. Appl. Sci. Eng.*, vol. 12, no. 1, pp. 19–28, 2021, doi: 10.1556/1848.2020.00110.

[35] I. H. T. Abdullah, S. Mat Zin, R. Che Mat, and W. N. I. Wan Alias, "Role of health and safety management practices in safety performance of Malaysian Bumiputera SMEs," *Int. J. Acad. Res. Bus. Soc. Sci.*, vol. 12, no. 1, Jan. 2022, doi: 10.6007/ijarbss/v12-i1/11854.

[36] E. Esterhuyzen and D. Visser, "Occupational health and safety in small businesses - A South African perspective," *Int. J. Entrep. Small Bus.*, vol. 46, no. 3, pp. 287–309, 2022.

[37] H. Ogunyomi, N. Bruning, and J. Raszkowski, "SMEs in Nigeria: Human resources and economic performance," *Int. J. Hum. Resour. Manag.*, vol. 27, no. 6, pp. 612–634, 2016.

[38] G. Sorensen et al., "Integrating worksite health protection and health promotion: A conceptual model for intervention and research," *Preventive Med.*, vol. 91, pp. 188–196, Aug. 2016, doi: 10.1016/j.ypmed.2016.08.005.

[39] E. J. Tetzlaff et al., "Safety culture: A retrospective analysis of occupational health and safety mining reports," *Safety Health Work*, vol. 12, no. 2, pp. 201–208, 2021.

[40] E. Cagno, G. J. L. Micheli, C. Jacinto, and D. Masi, "An interpretive model of occupational safety performance for Small- and Medium-sized Enterprises," *Int. J. Ind. Ergon.*, vol. 44, no. 1, pp. 60–74, Jan. 2014, doi: 10.1016/j.ergon.2013.08.005.

[41] D. Masi, E. Cagno, and G. J. L. Micheli, "Developing, implementing and evaluating OSH interventions in SMEs: A pilot, exploratory study," *Int. J. Occup. Safety Ergon.*, vol. 20, no. 3, pp. 385–405, 2014, doi: 10.1080/10803548.2014.11077059.

[42] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J. Bus. Res.*, vol. 133, pp. 285–296, Jun. 2021, doi: 10.1016/j.jbusres.2021.04.070.

[43] M. A. Fauzi, F. Mohamad, and N. Abdul Wahab, "Knowledge sharing via social media in higher education: A bibliometric analysis," *J. Appl. Res. Higher Educ.*, 2023, doi: 10.1108/JARHE-02-2023-0077.

[44] E. Pranckute, "Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world," *Publications*, vol. 9, no. 1, 2021.

[45] S. Echchakoui, "Why and how to merge Scopus and Web of Science during bibliometric analysis: The case of sales force literature from 1912 to 2019," *J. Mark. Anal.*, vol. 8, no. 3, pp. 165–184, 2020, doi: 10.1057/s41270-020-00081-9.

[46] S. E. H. Zyoud, W. S. Waring, S. W. Al-Jabi, and W. M. Sweileh, "Global cocaine intoxication research trends during 1975–2015: A bibliometric analysis of Web of Science publications," *Subst. Abuse Treat. Prev. Policy*, vol. 12, pp. 1–15, 2017, doi: 10.1186/s13011-017-0103-0.

[47] N. A. Kheni, G. F. Gibb, and A. R. J. Dainty, "Health and safety management within small- and medium-sized enterprises (SMEs) in developing countries: Study of contextual influences," *J. Constr. Eng. Manag.*, doi: 10.1061/(ASCE)CO.1943-7862.0000218.

[48] N. A. Kheni, A. R. J. Dainty, and A. G. F. Gibb, "Health and safety management in developing countries: A study of construction SMEs in Ghana," [Online]. Available: https://hdl.handle.net/2134/5942

[49] M. Segarra Cañamares et al., "Occupational risk-prevention diagnosis: A study of construction SMEs in Spain," *Safety Sci.*, vol. 92, pp. 104–115, Feb. 2017, doi: 10.1016/j.ssci.2016.09.016.

[50] S. Torp and B. E. Moen, "The effects of occupational health and safety management on work environment and health: A prospective study," *Appl. Ergon.*, vol. 37, no. 6, pp. 775–783, Nov. 2006, doi: 10.1016/j.apergo.2005.11.005.

[51] S. Niu, "Ergonomics and occupational safety and health: An ILO perspective," *Appl. Ergon.*, vol. 41, no. 6, pp. 744–753, Nov. 2010, doi: 10.1016/j.apergo.2010.03.004.

[52] M. A. Gopang, M. Nebhwani, A. Khatri, and H. B. Marri, "An assessment of occupational health and safety measures and performance of SMEs: An empirical investigation," *Safety Sci.*, vol. 93, pp. 127–133, Mar. 2017, doi: 10.1016/j.ssci.2016.11.024.

[53] S. Unnikrishnan, R. Iqbal, A. Singh, and I. M. Nimkar, "Safety management practices in small and medium enterprises in India," *Safety Health Work*, vol. 6, no. 1, pp. 46–55, Mar. 2015, doi: 10.1016/j.shaw.2014.10.006.

[54] J. A. Edwards and S. Webster, "Psychosocial risk assessment: Measurement invariance of the UK Health and Safety Executive's Management Standards Indicator Tool across public and private sector organizations," *Work Stress*, vol. 26, no. 2, pp. 130–142, 2012, doi: 10.1080/02678373.2012.688554.

[55] X. Hu, H. Yan, T. Casey, and C.-H. Wu, "Creating a safe haven during the crisis: How organizations can achieve deep compliance with COVID-19 safety measures in the hospitality industry," *Int. J. Hosp. Manag.*, vol. 92, p. 102662, 2021, doi: 10.1016/j.ijhm.2020.102662.

[56] E. Ikpe, F. Hammon, and D. Oloke, "Cost-benefit analysis for accident prevention in construction projects," *J. Constr. Eng. Manag.*, vol. 138, no. 8, pp. 991–998, 2012.

[57] P. Kongtip, W. Yoosook, and S. Chantanakul, "Occupational health and safety management in small and medium-sized enterprises: An overview of the situation in Thailand," *Safety Sci.*, vol. 46, no. 9, pp. 1356–1368, 2008, doi: 10.1016/j.ssci.2007.09.001.

[58] A. Marinaccio et al., "Nationwide epidemiological study for estimating the effect of extreme outdoor temperature on occupational injuries in Italy," *Environ. Int.*, vol. 133, p. 105176, Oct. 2019, doi: 10.1016/j.envint.2019.105176.

[59] Z. Turskis, S. Dzitac, A. Stankiuviene, and R. Šukys, "A fuzzy group decision-making model for determining the most influential persons in the sustainable prevention of accidents in the construction SMEs," *Int. J. Comput. Commun. Control*, vol. 14, no. 1, pp. 90–106, Feb. 2019.

[60] L. Vassie, J. M. Tomàs, and A. Oliver, "Health and safety management in UK and Spanish SMEs: A comparative study," *J. Safety Res.*, vol. 31, no. 1, pp. 35–43, 2000, doi: 10.1016/S0022-4375(99)00028-6.

[61] F. Niebuhr, P. Borle, F. Börner-Zobel, and S. Voelter-Mahlknecht, "Healthy and happy working from home? Effects of working from home on employee health and job satisfaction," *Int. J. Environ. Res. Public Health*, vol. 19, no. 3, 2022, doi: 10.3390/ijerph19031122.

[62] M. S. Mohandes and X. Zhang, "Developing a holistic occupational health and safety risk assessment model: An application to a case of sustainable construction project," *J. Cleaner Prod.*, vol. 291, 2021, doi: 10.1016/j.jclepro.2021.125934.

[63] J. Lee et al., "Risk perception, unhealthy behavior, and anxiety due to viral epidemic among healthcare workers: The relationships with depressive and insomnia symptoms during COVID-19," *Front. Psychiatry*, vol. 12, 2021, doi: 10.3389/fpsyt.2021.615387.

[64] J. Vásquez, S. Aguirre, E. Puertas, G. Bruno, P. C. Priarone, and L. Settineri, "A sustainability maturity model for micro, small and medium-sized enterprises (MSMEs) based on a data analytics evaluation approach," *J. Cleaner Prod.*, vol. 311, Jan. 2021, doi: 10.1016/j.jclepro.2021.127692.

[65] A. G. Khanzode, P. R. S. Sarma, S. K. Mangla, and H. Yuan, "Modeling the Industry 4.0 adoption for sustainable production in micro, small & medium enterprises," *J. Cleaner Prod.*, vol. 279, Feb. 2021, doi: 10.1016/j.jclepro.2020.123489.

[66] M. Tejamaya, W. Puspoprodjo, H. Susetyo, and R. Modjo, "An analysis of pivotal factors in the implementation of occupational health and safety management systems in MSMEs: Literature review," *Gac. Sanit.*, vol. 35, pp. S348–S359, 2021, doi: 10.1016/j.gaceta.2021.10.050.

[67] M. A. Fauzi, Z. A. Saad, M. H. Ahmad, M. Z. Fauzi, and M. F. Ahmad, "Investigating the emerging and future trends of knowledge management in small and medium enterprises: A science mapping approach," *Learn. Org.*, 2023, doi: 10.1108/TLO-06-2023-0091.

[68] I. Bernatović, A. Slavec Gomezel, and M. Černe, "Mapping the knowledge-hiding field and its future prospects: A bibliometric co-citation, co-word, and coupling analysis," *Knowl. Manag. Res. Pract.*, vol. 20, no. 3, pp. 394–409, 2022.

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